

REMARKS

Claims 1-68, 70-72, 74-75 and 80 have been canceled. Applicants reserve the right to file a divisional patent application for claims 1-68 which have been canceled without prejudice due to a restriction requirement. Claims 69, 73 and 76-79 and 81-89 are now pending in this patent application.

With respect to previously pending Claims 69 - 80, Claim 80 has been objected to as being dependent upon a rejected base claim. Thus, Claim 80 has been indicated to be allowable if rewritten.

In response, the Applicant has amended previous independent Claim 69 to incorporate the subject matter of previous Claims 70 - 72, 74, 75 and allowable Claim 80 and accordingly, Claims 70 - 72, 74, 75 and 80 have been canceled. Dependent Claims 73 and 76 - 79 have been amended to depend directly or indirectly from amended independent Claim 69.

In addition, the Applicant has added new Claims 81 - 89 herein. New independent Claim 81 has been added which incorporates the subject matter of previous Claims 69 - 72 and 74. New Claims 82 - 89 depend directly or indirectly from new independent Claim 81. Further, new dependent Claims 82 - 89 include the same subject matter as previous allowable Claim 80 and Claims 75, 73, 76, 77, 78, 79 and 75 respectively.

It is respectfully submitted that the previous rejections of the Examiner are overcome by the amendment to previous Claim 69 to include the subject matter of allowable Claim 80, by new independent Claim 81 and the remarks which follow.

Referring to the Office Action, the Examiner has rejected prior Claims 69 - 79 under 35 U.S.C. 102(b) and 102(a) as being anticipated by Canadian Application 2,268,867 published October 13, 2000 by Ivey et. al. and corresponding U.S. Patent No. 6,245,208 issued June 12, 2001 to Ivey et. al. respectively (collectively referred to herein as "Ivey").

Further, the Examiner has rejected prior Claims 69 - 74 under 35 U.S.C. 102(b) as being anticipated by Zakel et. al. ("Flip Chip Assembly Using Gold, Gold-Tin, and Nickel-Gold Metallurgy"...).

Finally, the Examiner has rejected prior Claims 69-73 under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 4,869,971 issued September 26, 1989 to Nee et. al.

The Applicant's invention as claimed in amended independent Claim 69 and new independent Claim 81 is directed a layered composite material comprising a layer of a first alloy species of an alloy having first alloy species properties and a layer of a second alloy species of the alloy having second alloy species properties, wherein the first alloy species properties are distinguishable from the second alloy species properties and wherein the alloy is comprised of gold and tin.

As discussed in the Application at Page 6, lines 14 - 16, "the term 'alloy species' indicates a substance which is electrodeposited by the process using a specific electroplating current, which substance may be comprised of one alloy phase or a combination of alloy phases." However, as stated at Page 6, lines 27 - 31, preferably, "a selected electroplating current electrodeposits primarily or essentially a single alloy phase so that any particular alloy species consists primarily or essentially of a single alloy phase." Accordingly, as further claimed in amended independent Claim 69 and new independent Claim 81, the first alloy species consists essentially of a first alloy phase and the second alloy species consists essentially of a second alloy phase.

As discussed with respect to the testing conducted in the within Application, each of the layers of the layered composite material is provided as a relatively uniform layer consisting essentially of a single alloy phase. For instance, at Page 45, lines 16 - 27 of the Application, a first multi-layer test was directed at "depositing a layer of one alloy phase on top of a layer of the other alloy phase." The results shown in Figure 22 show "that both layers are extremely uniform with good adhesion to one another." Further, the Application states at Page 47, lines 6 - 15 that the layered composite material contains "separate layers" of the different alloy phases.

Further, amended independent Claim 69 and dependent Claims 83 and 89 particularly claim the first alloy phase being Au₅Sn and the second alloy phase being AuSn. In addition, amended independent Claim 69 and dependent Claim 82 particularly claim the layered composite material being comprised of a plurality of layers of each of the first alloy species and the second alloy species.

First, referring to Ivey, the Examiner refers to Figure 14 and Page 22, lines 4 - 30 of the Canadian Application and Figure 14 and Column 16, lines 1 - 59 of the U.S. Patent, which references are substantially similar. In both cases, Figure 14 is directed at testing conducted to determine the length of time that the same plating solution could be used in the electrodeposition process. As stated at Page 22, lines 17 - 20 of the Canadian Application:

“Based on the above information, the number of InP wafers (2 inch diameter) that could be plated from the same bath without a significant composition change was estimated. If the process was scaled up to a 2 L plating solution and a 3.5 µm of solder was deposited on each wafer, then a total of U19 wafers could be plated before replenishing the bath.”

Figure 14 simply shows a depletion of the components or materials over time using a fixed current density. The layers apparently shown in Figure 14 are as a result of the depletion of the materials. In other words, the composition changes as the material depletes resulting in the layers shown in Figure 14.

In any event, Page 22, lines 8 - 10 of the Canadian Application of Ivey particularly describe the layers as follows with reference to Figure 14:

“The BSE images show 2 distinct layers. The inner layer consists of 2 phases and is U23 µm thick, while the outer layer (2-3 µm thick) appears to be a single phase and Au-rich.”

As stated, the inner layer consists of 2 phases. Further, these 2 phases are deposited simultaneously as a single layer. The phases are not deposited as defined, distinct or separate layers.

Accordingly, it is respectfully submitted that Ivey does not disclose, suggest or describe in any manner whatsoever a layered composite material comprising a layer of a first alloy species of an alloy consisting essentially of a first alloy phase, and further comprising a layer of a second alloy species of the alloy consisting essentially of a second alloy phase, as claimed in amended independent Claim 69 and new independent Claim 81. In fact, the statement in Ivey that the inner layer “consists of 2 phases” directly teaches away from the Applicant’s layered composite material as claimed in Claims 69 and 81.

Further, it is respectfully submitted that Ivey does not disclose, suggest or describe in any manner whatsoever a layered composite material comprised of a plurality of layers of each of the first alloy species and the second alloy species, as previously claimed in allowable Claim 80, and as presently claimed in amended independent Claim 69 and new dependent Claim 82.

Accordingly, it is respectfully submitted that amended independent Claim 69, new independent Claim 81 and new dependent Claim 82 are not anticipated by Ivey.

Second, referring to Zakel, the Examiner refers to Pages 430 - 431 which refer to the heating of “the Au-AuSn-AuSn₂-AuSn₄-Sn sandwich structure.” However, this reference arises in the context of a description of the electroplating of gold-tin solder bumps (see Page 427 of Zakel). Specifically, Zakel describes the electroplating of gold bumps with an additional step in which a tin cap is deposited as shown in Figure 15.5. Further, the tin cap is preferably “reflowed in order to obtain the eutectic 80/20 AuSn solder” (Page 427 of Zakel). As further described on Page 430 of Zakel:

“By a controlled reflow step in an inert atmosphere, the intermetallic compounds are transformed into the eutectic 80/20 AuSn alloy ... The

reflowed AuSn bumps **consist of** a hard core of Au located on the bottom of the bump, a ζ -phase layer, and a cap of eutectic 80/20 AuSn alloy.”

The reference to “the Au-AuSn-AuSn₂-AuSn₄-Sn sandwich structure” is made by Zakel on Page 430 with reference to Figure 15.8 which shows the intermediate steps during the reflow process and the metallurgical processes taking place. These “intermediate steps” shown in Figure 15.8 are not defined or distinct steps but rather a picture or snapshot of the metallurgical reactions occurring at a given time in the continuous process.

As described in Pages 430-431 of Zakel, during the first intermediate step, a “first tin-rich eutectic with 90 wt% Sn and a liquidus temperature of 217°C is formed. The compounds of this eutectic consist of Sn and AuSn₄ (Fig 15.8a).” During the second intermediate step, “by further solid-liquid diffusion, this first eutectic is fully consumed in AuSn₄. Furthermore, the AuSn₂ phase consumes AuSn₄ by solid-liquid diffusion. During all these processes, at the interface adjacent to Au, the phase AuSn is growing continuously by solid-state diffusion. ... After the full consumption of AuSn₂ only the compounds AuSn and Au remain.”

It is therefore respectfully submitted that Zakel does not disclose, suggest or describe in any manner whatsoever a layered composite material comprising a defined, distinct or separate layer of a first alloy species of an alloy consisting essentially of a first alloy phase, and further comprising a defined, distinct or separate layer of a second alloy species of the alloy consisting essentially of a second alloy phase, as claimed in amended independent Claim 69 and new independent Claim 81.

Further, it is respectfully submitted that Zakel does not disclose, suggest or describe in any manner whatsoever a layered composite material comprised of a plurality of layers of each of the first alloy species and the second alloy species, as previously claimed in allowable Claim 80, and as presently claimed in amended independent Claim 69 and new dependent Claim 82.

Finally, it is respectfully submitted that Zakel does not disclose, suggest or describe in any manner whatsoever a layered composite material wherein the first alloy phase is Au₅Sn and wherein the second alloy phase is AuSn, as claimed in amended independent Claim 69 and new dependent Claims 83 and 89.

Accordingly, it is respectfully submitted that amended independent Claim 69; new independent Claim 81 and new dependent Claims 82, 83 and 89 are not anticipated by Zakel.

Third, referring to Nee, the Examiner specifically states that the examples of Nee include the deposition of alternating layers of beta brass and alpha brass. In fact, the entire process and multi-layer deposit described by Nee relates entirely or solely to the deposition of brass as the alloy, being comprised of copper and zinc. Thus, the Examiner has not cited Nee against previous Claim 74 which claims a layered composite material comprised of layers of an alloy which is comprised of gold and tin.

Thus, it is respectfully submitted that Nee does not disclose, suggest or describe in any manner whatsoever a layered composite material comprising a layer of a first alloy species of an alloy and a layer of a second alloy species of the alloy, wherein the alloy is comprised of gold and tin, as claimed in amended independent Claim 69 and new independent Claim 81.

Accordingly, it is respectfully submitted that amended independent Claim 69 and new independent Claim 81 are not anticipated by Nee.

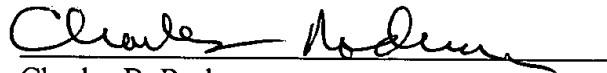
In summary, it is respectfully submitted that none of Ivey, Zakel or Nee anticipates the Applicant's invention as claimed in amended independent Claim 69 and new independent Claim 81. It is therefore respectfully submitted that amended independent Claim 69 and new independent Claim 81 are allowable and allowance of these Claim is respectfully requested.

Further, dependent Claims 73 and 76 - 79 all depend directly or indirectly from amended independent Claim 69, while dependent Claims 82 - 89 all depend directly or indirectly

from new independent Claim 81. Thus, it is respectfully submitted that these dependent Claims are allowable for the distinctions defined therein as well as for the reasons supporting the allowability of independent Claims 69 and 81. Allowance of these dependent Claims is therefore also respectfully requested.

In view of the foregoing amendments and remarks, it is submitted that this Application is in condition for allowance and allowance is respectfully requested.

Respectfully submitted,
RODMAN & RODMAN

A handwritten signature in black ink, appearing to read "Charles B. Rodman", is written over a horizontal line.

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